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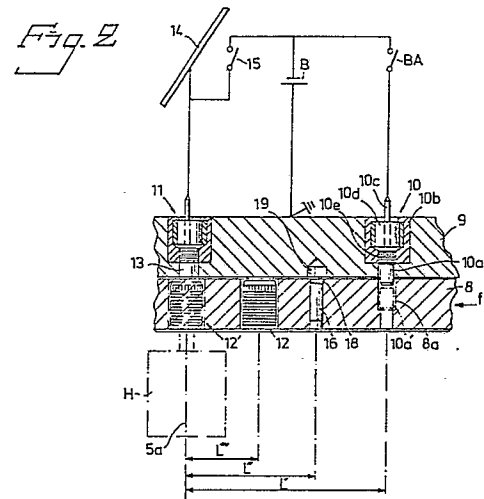
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The title of the invention has been amended (Guidelines for Examination in the EPO, A-III, 7.3).

54 **Fuse.**

57 An ammunition unit is disposed for firing from a gun. The ammunition unit is provided with a fuze which includes electronics with an associated electrical trajectory safety device (BA) which prevents arming of the ammunition unit within a trajectory safety distance. A movable portion (8) may be activated with the aid of an arming igniter (10) which is actuable with the electrical trajectory safety device (BA). upon its activation, the movable portion executes an instantaneous movement in which it moves a bursting cap (12) disposed in the movable portion into an arming position (12') in register with the initiation detonator (11) which is included in a detonation chain actuable by means of an impact or a proximity fuze contact. The movable portion (8) is also lockable by locking means in the form of a pin which is actuable on a retardation in the ammunition unit caused by a first hit of the ammunition unit against a first object located within the trajectory safety distance. Upon its activation, the locking device realizes a locking of the movable portion which is thereafter prevented from executing the above-mentioned instantaneous movement even if the first hit were to cause such mechanical action on the electronics as entails activation of the arming igniter. Thereby, the ammunition unit will, on a second hit, assume the safe position entailing that total bursting of the ammunition unit

through the intermediary of the bursting cap is prevented if such bursting is caused by shock-triggering of the bursting cap in the unsafe position.



Description

IMPROVEMENTS TO FUZES

TECHNICAL FIELD

The present invention relates to a fuze arrangement for an ammunition unit fireable from a gun, the fuze comprising electronics with an associated electrical trajectory safety device which prevents arming of the ammunition unit within a trajectory safety distance, and an arming detonator which is triggerable by the trajectory safety device after the trajectory distance and is intended for a movable part, for example a rotor or slide, which, on triggering of the arming safety device executes an instantaneous movement in which it displaces a blasting cap disposed in the movable portion to its arming position in register with an initiation detonator which is included in an ignition chain which may be activated by means of a contact, for instance an impact contact, proximity fuze contact, etc.

BACKGROUND ART

Similar types of fuzes are previously known in the art. The trajectory safety is intended to activate the arming igniter within a trajectory safety distance which may be selected at between 50 and 150 metres from the muzzle of the gun. The trajectory safety device may receive activation in conjunction with the movement in the barrel of the gun, for example with the aid of induction, and in addition the trajectory safety contact operates with a certain time lag which ensures the above-mentioned trajectory safety distance. The trajectory safety device may also be activated mechanically by the acceleration which occurs in conjunction with firing of the gun. The arming igniter may be of that type which utilizes a locking pin which locks the slide to a fixed portion in the ammunition unit on the movement thereof in the trajectory safety region. The pin is displaced from its engagement with the fixed portion or the movable portion with the assistance of an ignition charge which may be activated by means of the above-mentioned electric trajectory safety device. The initiation detonator may also be electrically initiated. On activation of the arming detonator, the movable portion (the rotor) executes an instantaneous movement during a few milliseconds when the detonation cap is moved to its arming position in register with the initiation detonator which may be activated by means of the above-mentioned impact contact or the like. The electronics of the fuze, like the design of ignition charges, contacts etc. are previously known in the art.

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

It is vital that the ammunition unit is not detonated within the region of the trajectory safety distance, int. al. because there are inflexible demands that the gun crew be protected from such explosions. However, firing may take place in terrain where objects are located within the region of the trajec-

tory safety distance, for example, trees, buildings etc. In electrically triggerable fuzes, there is the risk that if the ammunition unit hits an object within the trajectory safety distance, the electronics of the unit will be destroyed so that the continued sequence of events becomes uncontrollable. For instance, the mechanical influence on the electronics in the event of such a hit could cause the arming detonator to be activated and the detonation cap to be moved to its armed position. In the event of a subsequent additional hit against another object within the trajectory safety distance, the detonation cap could, consequently, be shock-ignited, which would result in complete explosion of the ammunition unit within the trajectory safety distance.

There is therefore a manifest need in the art to prevent, in fuzes operating with electric trajectory safety devices, explosions of the above-discussed type within the trajectory safety distance.

SOLUTION

The primary object of the present invention is to propose a fuze arrangement which solves the above-outlined problem structure, and that which may substantially be considered as characterizing the new arrangement is, int. al., that the movable portion is lockable by means of a locking device, for example in the form of a pin-like device, which is actuatable on a non-shock-triggering first hit of the ammunition unit against a first object located within the trajectory safety distance, the object possibly consisting of a tree, a building etc. Further characterizing features of the arrangement according to the present invention are that the locking device, on its activation upon the above-mentioned first hit, will realize a locking of the movable portion which is thereafter prevented from executing the above-mentioned instantaneous movement, even if the above-mentioned first hit were to cause such mechanical influence to the electronics as entails activation of the arming igniter, the ammunition unit, on a non-shock-triggering second hit against a further object within the trajectory safety distance, assuming a safe position and thereby preventing triggering of the ammunition unit because the detonation cap is shock-detonated upon the above-mentioned second hit.

In further developments of the inventive concept as herein disclosed, the pin-like device is disposed in a first recess in the movable portion. The recess extends in the longitudinal direction of the ammunition unit. This first recess is then disposed facing a second recess in a fixed portion included in the ammunition unit. The pin-shaped device may be arranged, for a retardation caused by the above-mentioned first hit, to be activated for its operation where it enters into engagement with the above-mentioned first portion in that it is displaced relative to the first portion and penetrates, with its forward region, into the above-mentioned second recess and thus locks the movable portion to the fixed

portion.

The pin-shaped device is preferably disposed in its recess with a clearance which may consist of a few hundredths of a millimetre. Hence, the pin-shaped device is essentially loosely displaceable in the recess with the aid of the above-mentioned retardation. The second recess displays a diameter which exceeds the diameter of the first recess. The diameter of the second recess may exceed that of the first recess by, for instance, 10-30 per cent. The first and second recesses are disposed opposite one another in an initial position of the moving portion, i.e. the centre lines of the recesses substantially coincide.

In the case involving a rotor, the pin-shaped device and the above-mentioned recesses are located beside the axis of rotation of the ammunition unit. The pin-shaped device locks the movable portion to the fixed portion in that the portions interact with side surfaces on the pin-shaped device with the assistance of the rotational forces in the ammunition unit.

ADVANTAGES

Physical application of the arrangement according to the present invention will realize a simple solution to a technically difficult problem by the utilization of a loosely inserted pin-shaped device. The acceleration forces in the ammunition unit on its discharge from the gun will ensure that the pin-shaped device assumes a non-locking position on discharge. Only on the occurrence of a retardation in conjunction with the first hit can the pin-shaped device be longitudinally displaced for interaction with the fixed portion and thereby for locking of the movable portion to the fixed portion. On the occurrence of this retardation, the ignition fuze will make safe the ammunition unit which thereafter can only be activated by shock-ignition of the secondary explosive charge because of impact on a sufficiently hard target.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

A currently proposed embodiment of an arrangement displaying the characteristics significative of the present invention will be described in greater detail below with reference to the accompanying drawings, in which:

Fig. 1 schematically illustrates the discharge from a gun of an ammunition unit which, within the trajectory safety distance, strikes first and second objects in the form of trees,

Fig. 2 shows, in partial cross-section, relevant parts of the fuze and ammunition unit in which the fuze is disposed,

Fig. 3 shows, in cross section, a preferred embodiment of a locking device included in the fuze of Fig. 2, and functioning as a mechanical trajectory safety device which supplements the electrical trajectory safety device according to Fig. 2,

Fig. 4 shows, in cross-section, the position of the locking device in which it holds the movable and fixed portions mutually locked, and

Fig. 5 shows the forces occurring on the locking device according to Figs. 3 and 4.

DETAILED DESCRIPTION OF EMBODIMENT

In Fig. 1, a gun or similar artillery piece is symbolized by its barrel 1. The trajectory safety distance L may be selected in a conventional manner and may be, for instance, from 50 to 150 metres. It is assumed that in the firing action under consideration here objects in the form of trees 2 and 3 are located within the trajectory safety distance L. These trees have unintentionally fallen in the line of fire 4 of an ammunition unit which is represented in two positions, of which the first position is designated 5 and the second position 5'. Upon discharge of the ammunition unit, a first hit 6 has occurred between the ammunition unit and the tree 2 and a second hit 7 between the ammunition unit and the tree 3.

If, in the case described with reference to Fig. 1 conventional fuzes with a trajectory safety device of the electric type are employed, it could happen that the electrical trajectory safety device and/or the electronics intended therefore could activate the arming igniter so that the ammunition unit, on the second hit 7, assumes the armed position, which could cause detonation of the ammunition unit by shock to complete explosion for bursting.

Fig. 2 shows relevant parts of the ammunition unit and the mutual positions of these parts before the first hit 6. These parts, which may substantially be referred to the fuze of the ammunition unit, include a movable portion in the form of a rotor 8 rotatable around the centre axis 5a of the ammunition unit. The rotation may be effected with the assistance of rotational forces and/or spring force f. There are also shown on the drawing parts of a portion 9 included in the ammunition unit which are fixed in relation to the movable portion 8. The rotor is provided with an arming igniter 10 which includes a locking pin 10a which is disposed, within the trajectory safety distance L, to hold the movable portion 8 locked to the fixed portion 9. In the illustrated position, the pin 10a thus extends with portions both into the movable and the fixed portion, these portions 8 and 9 being provided with corresponding recesses. Beyond the trajectory safety distance, the arming igniter 10 is to be activated, which implies that the pin 10a is urged out of its interaction with one of the portions 8 and 9. In the present case, the pin 10a is actuated to a position in the recess 8a of the movable portion 8, where the pin has become disengaged from the fixed portion 9. This position of the pin 10a has been designated 10a' in Fig. 2. The activation of the arming igniter is realized with the assistance of a prior-art electric igniter 10b which may be actuated by a trajectory safety contact BA. Activation of the trajectory safety device takes place in conjunction with discharge of the ammunition unit from the gun 1 in a per se known manner, for example with the assistance of magnetic circuits which realize induction. When the contact BA is made, the electric igniter is initiated after a certain time lag, at which point the pin is displaced into the fixed portion to its position 10a'. The electric igniter has an electrode 10c, a glass body 10d and a

pyrotechnical charge 10e. The charge is forced against the one end surface of the body at which electric contact means extend between the electrode 10c and the earthed body of the electric igniter. When the current circuit is made, electric contact means are heated and ignite the charge 10e which will then realize displacement of the pin 10a.

The fixed portion also carries an initiation detonator 11 which is also of per se known electric type and is designed and operates in a manner corresponding to that of the fuze 10. In addition, the movable portion 8 carries a bursting cap 12 which is operative to realize instantaneous activation of a main charge H associated with the carrier. On release of the movable portion from the fixed portion, the movable portion 8 will be influenced in a per se known manner such that the bursting cap is turned to a position 12' where it is placed in register with the eye 13 of the initiation fuze. In the position 12' of the bursting cap, the fuze is armed and the ammunition unit may thereafter be detonated through the intermediary of an impact contact, for example of the double shell type, and/or a proximity fuze contact 15 symbolically intimated in Fig. 2, both of these respective contacts 14 and 15 appropriately consisting of per se known types. In the position 12', the initiation igniter is, in the illustrated case, triggerable electrically from the contact 14 or 15, respectively, upon whose activation a current circuit is made from the positive pole of the battery B through the intermediary of the initiation igniter and the negative pole of the battery. Triggering of the electric fuze 10 is effected in a corresponding manner through the intermediary of the positive pole of the battery, the trajectory safety contact BA and the negative pole of the battery.

The movable portion also carries a pin-shaped device 16 which serves as an extra mechanical trajectory safety device, in the event that a hit situation, for instance corresponding to that described with reference to Fig. 1, occurs. The arming safety device 10 is placed at a distance L', the trajectory safety element 16 at a distance L'' and the bursting cap 12 at a distance L''' from the axis of rotation 5a of the ammunition unit. Naturally, the dispositions of the different units within the movable portion may be varied without departing from the inventive concept as herein disclosed.

According to Fig. 3, the safety device 16 consists of a pin-shaped member 17 disposed in a recess 18 in the portion 8. A recess 19 corresponding to the recess 18 is disposed in the portion 9. The recess 18 is of a diameter D' of, for example, 0.85 mm. The diameter d of the pin 17 is less than the diameter D' by a few hundredths of a millimetre, for example by 5-10 hundredths of a millimetre. The recess 19 is of a diameter D'' which exceeds the diameter D' by approx. 10-30 per cent. The pin-shaped member is of a height H of approx. 2 mm. The height H' of the recess in the portion 9 is approx. 0.5 mm. The pin-shaped member is substantially of the same length as the recess 18. When the pin-shaped member assumes the position illustrated in Fig. 3, its end surface 17a is substantially flush with the cap 20 between the movable and fixed portions.

Fig. 4 shows the case in which the pin 17 has been

moved by retardation forces F forwardly so that the forward parts 17b are located in the recess 19. Relevant parts of the circumferential surface 17c interact in this instance with the walls 18a and 19a in the recesses 18 and 19. The pin 17 is retained in the position as shown in Fig. 4 as a result of the friction between the side surfaces of the pin and the walls of the recesses. This friction is realized by the rotation (centrifugal force) of the ammunition unit about its longitudinal axis 5a (see Fig. 2).

Fig. 5 shows those forces which act on the pin-shaped member 17. The retardation force is designated F_R and is equal to $m \cdot a_r$. The rotational force F_a is equal to $m \cdot r \cdot W^2$. The frictional force $F_f = \mu \cdot m \cdot r \cdot W^2$. The distance between the centre line 21 of the pin-shaped member and the axis of rotation 5a is indicated in Fig. 5 by r (cf. L'' in Fig. 2). The pin-shaped member is of steel. As a result of the disclosed construction and disposition, it is possible for the pin-shaped member to move forward and lock the movable portion on the first hit 6 and retain the locking according to Fig. 4 on the second hit 7. The fuze will thereafter assume a safe position during the continued flight of the ammunition unit. The ammunition unit can nevertheless be shock-detonated by direct impact on a target.

The pin-shaped member can be retained in its locking position for the movable portion by means of torque forces f on the movable portion. These torque forces f can form an alternative or supplementary locking force to the locking forces mentioned in the foregoing which are obtained from the rotation.

The present invention should not be considered as restricted to that described above and shown on the drawings, many modifications being conceivable without departing from the spirit and scope of the appended Claims.

Claims

1. A fuze arrangement for an ammunition unit (5, 5') dischargeable from a gun (1), in which the fuze includes electronics with an associated electrical trajectory safety device (BA) which prevents arming of the ammunition unit within a trajectory safety distance (L), and an arming igniter actuatable by the trajectory safety device after the trajectory safety distance, for a movable portion (8), for example a rotor, which, on activation of the arming igniter (10), executes an instantaneous movement in which it moves a bursting cap (12) disposed in the movable portion to the arming position in a detonation chain including an initiation detonator (11) actuatable by means of a contact (14, 15), for example an impact contact, a proximity fuze contact, etc. characterized in that the movable portion is lockable by means of a locking device, for example in the form of a pin-shaped member (16, 17), which is actuatable on a first hit (6) of the ammunition unit (5) against an object located within the trajectory safety distance (L);

that the locking device, upon its activation on said first hit, realizes a locking of the movable portion (8) which thereafter is prevented from executing said instantaneous movement even if said first hit (6) occasions such mechanical influence on the electronics and/or the electrical trajectory safety device (BA) which entails activation of the arming igniter (10), the ammunition unit, upon a second hit (7) against a further object (3) within the trajectory safety distance, assuming the safe secured position and thereby preventing total bursting of the ammunition unit occasioned by the shock-triggering of the bursting cap on said second hit (7).

2. The arrangement as claimed in Claim 1, characterized in that said pin-shaped member (17) is disposed in the movable portion in a first recess (18) extending in the longitudinal direction of the ammunition unit, said recess being disposed opposing a second recess (19) in a fixed portion (9) included in the ammunition unit.

3. The arrangement as claimed in Claim 2, characterized in that said pin-shaped member (17) is disposed, for a retardation (F_R) in the ammunition unit caused by said first hit, to be activated for operation and enter into interaction with said fixed portion (9) in that it is displaced in relation thereto and penetrates with its forward portion (17b) into said second recess (19).

4. The arrangement as claimed in Claim 1 or 2, characterized in that said pin-shaped member (17) is disposed in the first recess (18) with a clearance of preferably a few hundredths of a millimetre and thus is loosely displaceable in the recess by said retardation (F_R).

5. The arrangement as claimed in any one of Claims 2-4, characterized in that the second recess displays a diameter which exceeds the diameter of the first recess (18) by 10-30 per cent.

6. The arrangement as claimed in any one of Claims 2-5, characterized in that the first and second recesses (18 and 19, respectively) are, in an initial position of the movable portion (8) disposed in opposition to one another such that the centre lines of the recesses substantially coincide.

7. The arrangement as claimed in any one of Claims 2-6, characterized in that said pin-shaped member and said recesses are located beside the axis of rotation (5a) of the ammunition unit.

8. The arrangement as claimed in any one of Claims 2-7, characterized in that the locking of the movable portion (8) to the fixed portion (9) is effected by the interaction of the movable and fixed portions with side surfaces on parts of the pin-shaped member disposed in the first and second recesses.

9. The arrangement as claimed in any one of the preceding Claims, characterized in that the acceleration of the ammunition unit in the gun

(1) ensures that the locking device (16) assumes a non-locking position of the movable portion to the fixed portion until such time as the first hit (6) may possibly occur, whereafter the effect occasioned by said hit, for example a retardation of the ammunition unit, longitudinal displacement movement and/or rotational movement entail actuation, for example longitudinal displacement, of the pin-shaped member (17).

10. The arrangement as claimed in any one of the preceding Claims, characterized in that the locking device (16) is disposed to retain its locking position with the assistance of an influential force (f) for the motional actuation of the movable portion from the unarmed to the armed position.

Fig. 1

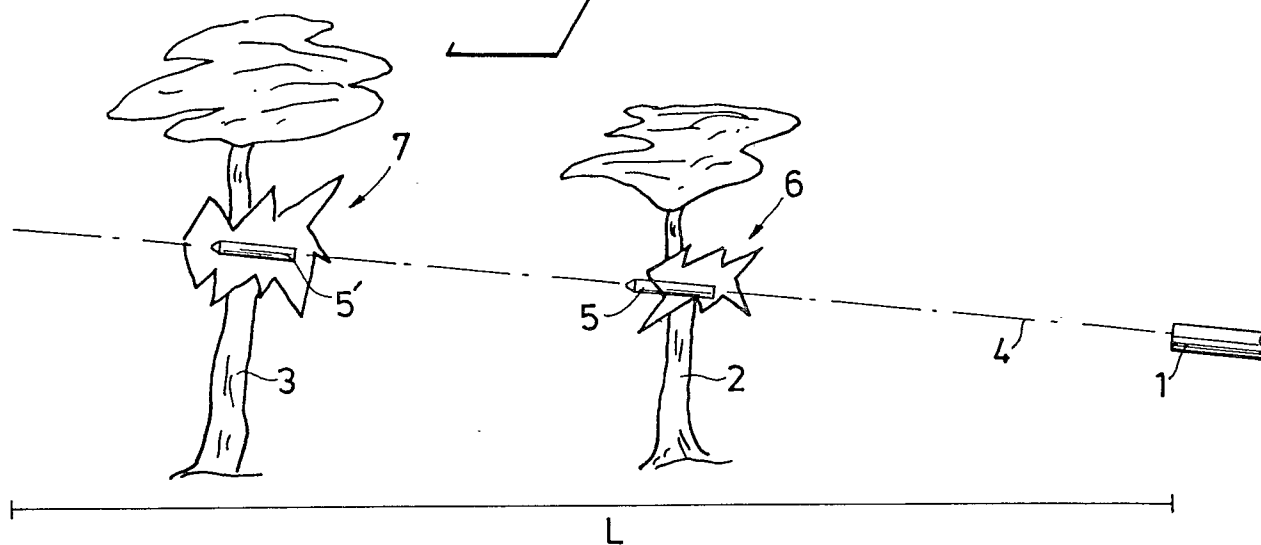


Fig. 2

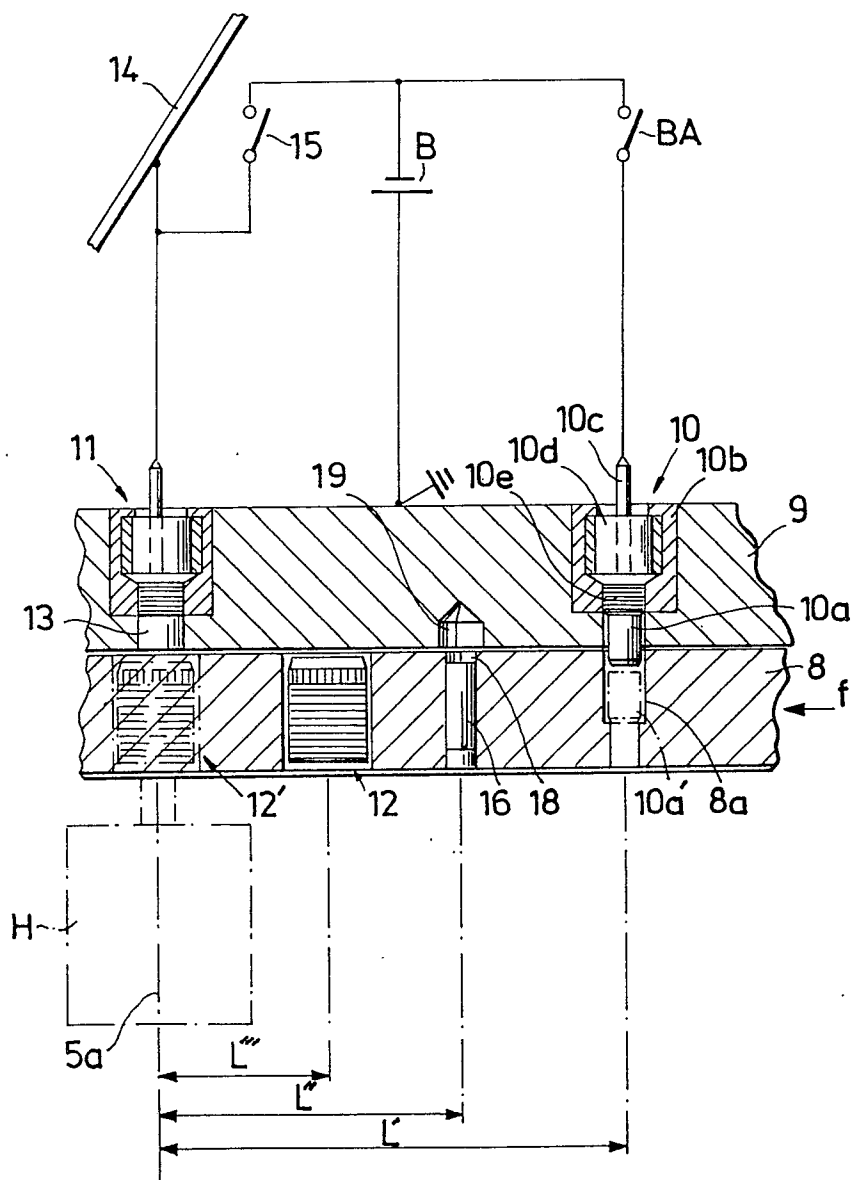


Fig. 3

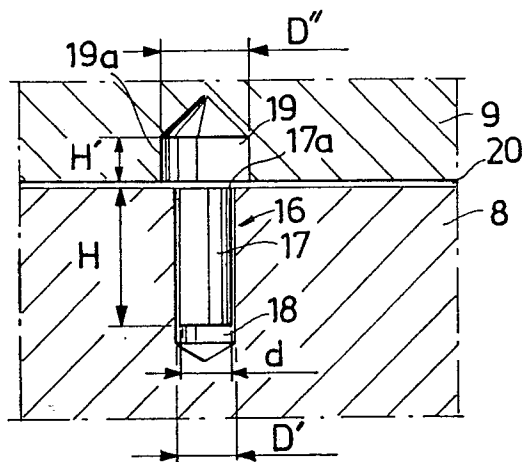


Fig. 4

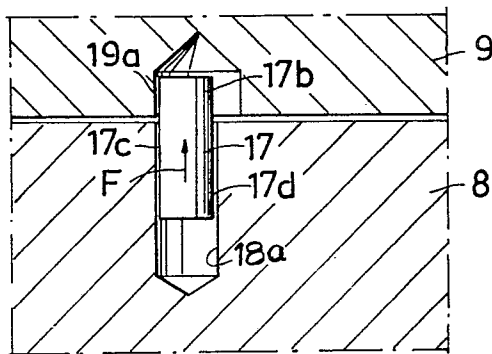


Fig. 5

